UNITED STATES PATENT AND TRADEMARK OFFICE

clo

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/621,795	07/21/2000	Daniel N. Miller	LOCK1260-1	4580

7590 03/19/2004

Robert A. McLauchlan
Koestner Bertani LLP
P.O. Box 26780
Austin, TX 78755

EXAMINER	
KIM, TAE JUN	

ART UNIT	PAPER NUMBER
3746	28

DATE MAILED: 03/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 09/621,795	Applicant(s) MILLER ET AL.
	Examiner Ted Kim	Art Unit 3746

M

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *31-33,35-38,40-42,44, 46-49, 51-57,59-63, 65-68, 70-82* is/are pending in the application.

4a) Of the above claim(s) *44,46-49,63,65-68,70-74,79,81 and 82* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *31-33,35-38,40-42,51-57,59-62,75-78 and 80* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 2/2/04 has been entered.

Election/Restrictions

2. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, 80, drawn to an apparatus for vectoring a nozzle, classified in class 60, subclass 232.

II. Claims 44, 46-49, 63, 65-68, 79, 81, drawn to a method for vectoring a fluid, classified in class 60, subclass 204.

III. Claims 70-74, 82, drawn to a method of designing a nozzle, classified in class 239, subclass 265.11.

The inventions are distinct, each from the other because of the following reasons:

3. Inventions I and II are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP §

806.05(e)). In this case the product requires a controller to control the injectors and the method does not. Alternately, the method is applied to a 3-D nozzle but the apparatus can be applied in its broadest claims to non-3D nozzles, including 2-D nozzles.

4. Group III has already been withdrawn from consideration by constructive election by original presentation as they are claims 70-74, 82 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: they are directed to a method of designing a nozzle, with steps comprising analyzing a baseline configuration, establishing a design study matrix..., etc. These method design steps are distinct from the rest of the claims, which claim an actual nozzle or an actual method of vectoring a nozzle.

5. During a telephone conversation with Robert McLaughlin on March 8, 200 a provisional election was made with traverse to prosecute the invention of group I, claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, 80,

6. Affirmation of this election must be made by applicant in replying to this Office action. Claims 44, 46-49, 63, 65-68, 70-74, 79, 81, 82 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

8. Claim 38, 57 are rejected under 35 U.S.C. 112, first paragraph, because the specification, does not reasonably provide enablement for providing a symmetric flow to vector the primary flow (compare with claim 16). Symmetric flows by definition cannot provide vectoring. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make or use the invention commensurate in scope with these claims.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 31-33, 35-38, 75, 76, 78 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The claims are indefinite because there is no structure defined for the primary flow in which a throat or sonic plane should necessarily exist. There is no nozzle, converging portion, diverging portion, throat, etc defined in the claims.

- Claim 31, line 6, "primary injector located {???} wherein" makes it indefinite where the primary injector could possible be located. See also claim 78.
- Claim 78, line 8, "said injector" is unclear as to which injector is referred to.

Claim Objections

11. Claims 42 and 61 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim.

Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form.

Double Patenting

12. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington,* 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

13. Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-77 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-46 of U.S. Patent No. 6,112,512. Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims of U.S. Patent No. 6,112,512, contains all the claim limitations of at least the independent claims of the instant application. For reference, the claims of US 6,122,512 are reproduced here

> 1. A control system for vectoring a primary flow within a small area expansion ratio nozzle by varying an effective throat of the small area expansion ratio nozzle, comprising:
>
> an opening for accepting the primary flow;
>
> a smooth converging portion of the nozzle wherein the primary flow is at a subsonic velocity;

a throat coupling said converging portion to a diverging portion of the nozzle downstream of said throat;

at least one primary injector located proximate to the throat wherein said at least one injector is inclined to oppose the primary flow;

at least one supplemental injector wherein the at least one supplemental injector is located in the nozzle downstream of the at least one primary injector, wherein said at least one supplemental injector is inclined to oppose the primary flow, and wherein the at least one primary and supplemental injectors provide a cross flow field opposed to a subsonic portion of the primary flow in order to vary an effective throat within the nozzle; and

at least one controller operable to direct said at least one primary and supplemental injector to provide a pulsed cross flow operable to vary the effective throat within the nozzle.

2. The control system of claim 1, wherein said cross flow field has predetermined frequency.

3. The control system of claim 1, wherein said pulsed cross flow has predetermined amplitude.

4. The control system of claim 1, wherein said pulsed cross flow has predetermined wave form.

5. The control system of claim 1, wherein a location, size, and/or orientation of said effective throat are varied.

6. The control system of claim 1, further comprising:

at least one mechanical actuator coupled to said at least one controller, wherein said at least one controller directs said at least one mechanical actuator to provide at least one fluidic pulse to said at least one primary and supplemental injector.

7. The control system of claim 6, wherein said at least one mechanical actuator comprises a mechanical valve.

8. The control system of claim 6, wherein the at least one mechanical actuator comprises an acoustic vibrator.

9. The control system of claim 6, wherein said at least one primary and supplemental injector rotates relative to said throat of the nozzle.

10. The control system of claim 1, wherein said controller further comprises:

a processor operable to execute software instructions to control the effective throat of the nozzle over a range of operating conditions.

11. The control system of claim 1, wherein a fluidic pulse from said at least one supplemental injector is operable to skew a boundary of a sonic plane of the nozzle towards said at least one supplemental injector.

12. The control system of claim 1, wherein the primary flow through the nozzle has a temperature and wherein said pulsed cross flow throttles the primary flow by decreasing the effective cross sectional area of the throat to control said temperature of the primary flow.

13. The control system of claim 1, wherein the primary flow through the nozzle has a pressure and wherein said pulsed cross flow throttles the primary flow by decreasing the effective cross sectional area of the throat to control said pressure of the primary flow.

14. The control system of claim 1, wherein the primary flow through the nozzle has a massflow and wherein said pulsed cross flow throttles the primary flow by decreasing the effective cross sectional area of the throat to control said massflow of the primary flow.

15. The control system of claim 1, wherein said at least one primary and supplemental injector provides a symmetric cross flow field.

16. The control system of claim 1, wherein said at least one injector provides an asymmetric cross flow field in order to vector a primary flow exhaust from the nozzle.

17. The control system of claim 1, wherein said at least one controller directs said at least one primary and supplemental injector to simultaneously throttle and vector the primary fluidic flow.

18. The control system of claim 1, wherein the nozzle is a fixed geometry nozzle.

19. The control system of claim 1, wherein the nozzle is a variable geometry nozzle.

20. The control system of claim 1, wherein the nozzle is integral to a jet engine onboard an aircraft.

21. The control system of claim 1, wherein said pulsed cross flow comprises fuel injected by said at least one primary and supplemented injector.

22. The control system of claim 21, wherein said injected fuel serves as an after burner.

23. The control system of claim 1, wherein said at least one primary and supplemental injector injects a sonic pulsed cross flow.

24. The control system of claim 1, wherein said at least one primary and supplemental injector injects a subsonic pulsed cross flow.

25. The control system of claim 1, wherein said at least one primary and supplemental injector injects a supersonic pulsed cross flow.

26. A control system for vectoring an exhaust flow within a small area expansion ratio nozzle of a jet engine by varying an effective throat of the small area expansion ratio nozzle, comprising:

an opening for accepting the primary flow;

a converging portion of the nozzle wherein the primary flow is at a subsonic velocity;

a throat coupling said converging portion to a diverging portion of the nozzle downstream of said throat;

at least one primary injector located proximate to the throat wherein said at least one injector is inclined to oppose the primary flow;

at least one supplemental injector wherein the at least one supplemental injector is located in the nozzle downstream of the at least one primary injector, wherein said at least one supplemental injector is inclined to oppose the primary flow, and wherein the at least one primary and supplemental injectors provide a cross flow field opposed to a subsonic portion of the primary flow in order to vary an effective throat within the nozzle; and

at least one controller operable to direct said at least one primary and supplemental injector to provide a pulsed cross flow operable to vary the effective throat within the nozzle.

27. The control system of claim 26, wherein said cross flow field has predetermined frequency.

28. The control system of claim 26, wherein said pulsed cross flow has predetermined amplitude.

29. The control system of claim 26, wherein said pulsed cross flow has predetermined wave form.

30. The control system of claim 26, wherein a location, size, and/or orientation of said effective throat are varied.

31. The control system of claim 26, further comprising:

at least one mechanical actuator coupled to said at least one controller, wherein said at least one controller directs said at least one mechanical actuator to provide at least one fluidic pulse to said at least one primary and supplemental injector.

32. The control system of claim 31, wherein said at least one mechanical actuator comprises a mechanical valve.

33. The control system of claim 31, wherein the at least one mechanical actuator comprises an acoustic vibrator.

34. The control system of claim 31, wherein said at least one primary and supplemental injector rotates relative to said throat of the nozzle.

35. The control system of claim 26, wherein said controller further comprises:

a processor operable to execute software instructions to control the effective throat of the nozzle over a range of operating conditions.

36. The control system of claim 26, wherein a fluidic pulse from said at least one supplemental injector is operable to skew a boundary of a sonic plane of the nozzle towards said at least one supplemental injector.

37. The control system of claim 26, wherein said at least one primary and supplemental injector provides a symmetric cross flow field.

38. The control system of claim 26, wherein said at least one injector provides an asymmetric cross flow field in order to vector a primary flow exhaust from the nozzle.

39. The control system of claim 26, wherein said at least one controller directs said at least one primary and supplemental injector to simultaneously throttle and vector the primary fluidic flow.

40. The control system of claim 26, wherein the nozzle is a fixed geometry nozzle.

41. The control system of claim 26, wherein the nozzle is a variable geometry nozzle.

42. The control system of claim 26, wherein said pulsed cross flow comprises fuel injected by said at least one primary and supplemental injectors.

43. The control system of claim 42, wherein said injected fuel serves as an after burner.

44. The control system of claim 26, wherein said at least one primary and supplemental injectors inject a sonic pulsed cross flow.

45. The control system of claim 26, wherein said at least one primary and supplemental injectors inject a subsonic pulsed cross flow.

46. The control system of claim 26, wherein said at least one primary and supplemental injectors inject a supersonic pulsed cross flow.

14. Claims 78, 80 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable 1-46 of U.S. Patent No. 6,112,512 in view of either Terrier or Justice. U.S. Patent No. 6,112,512 does not teach the 3D or ultra high aspect ratio biconvex or trapezoid aperture nozzle. Terrier teaches (fig. 8) that ultra high aspect ratio biconvex aperture (3D) nozzles are old and well known in the fixed nozzle art. Justice teaches that it is old and well known in the fixed nozzle art to employ a 3D ultra high aspect ratio trapezoid aperture nozzle 33B (col. 2, circa line 63). It would have been obvious to one of ordinary skill in the art employ a 3D nozzle, as taught by either Terrier or Justice, as well known types of fixed nozzles utilized in the art.

Claim Rejections - 35 USC § 102

15. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

16. Claim 80 is rejected under 35 U.S.C. 102(b) as being anticipated by Terrier (5,664,415). Terrier teaches a system for vectoring a primary flow comprising: a 3 D nozzles (see Figs 6-9 where the 3D aspect is readily apparent) having an inner surface and a throat, wherein the throat comprises a region within the 3D nozzle of lowest cross section area, the throat being in a path of primary flow of fluid; a plurality of primary injectors arranged along the inner surface of the 3D nozzle, the plurality of primary injectors 24 are individually arranged to oppose the primary flow of fluid in a first

intended vectoring plane, and wherein said primary injectors skew an effective throat or sonic plane within said 3D nozzle.

Claim Rejections - 35 USC § 103

17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

18. Claims 31-33, 35, 37, 38, 40-42, 51-57, 59-61, 75, 77, 78, 80, are rejected under 35 U.S.C. 103(a) as being unpatentable over McCullough (3,698,642) in view of either Ernst (3,294,323) or the AIAA paper of Miller et al. (AIAA 95-2603) of the IDS. McCullough teaches a nozzle having a primary flow, a primary injector 16, and a secondary injector 18, and valve controllers 22 to direct a flow to vary the effective throat area of the nozzle and perform thrust vectoring (top of col. 2). McCullough further teaches the use of fuel (col. 2, lines 26-28). Alternately, for the controllers, it is clear that the valves require a controller to actuate them. It would have been obvious to one of ordinary skill in the art to employ a controller in addition to the valves, in order to provide the necessary control over the thrust vectoring and/or throat control. McCullough do not teach the primary and secondary injectors are inclined to oppose the flow. Ernst teaches that it is old and well known in the thrust vectoring art to employ primary and secondary injectors 1, 3 that are either angled perpendicular to the primary

flow (Fig. 1) or inclined to oppose the flow (Fig. 3) and shows that the effective vector O can be increased by using opposed flow (compared Fig. 3 to Fig. 1). Miller et al. teach a fixed geometry exhaust nozzle used for gas turbine/turbofan engines (which inherently employ compressors) where the nozzle area is varied by a cross flow injected in the upstream direction (Figs. 2-5) in order to achieve a variable throat area. At the throat, the primary flow reaches the sonic condition. Miller shows on the cover sheet of the paper that the flows from the primary and secondary injectors can be angled to oppose the flow. Miller et al further teach very low injection angles are possible (see top left of fig. 9) and hence, as the angles are very low, the angles will also be approximately parallel the vector angle, which would also be low. It would have been obvious to one of ordinary skill in the art to incline the injectors of McCullough to oppose the flow, as taught by either Ernst or Miller et al, in order to enhance the effectiveness of the thrust vectoring and/or to employ an alternative means of vectoring well established in the art. As for using the nozzle with a jet engine aboard an aircraft, this is taught by the Miller paper. It would have been obvious to one of ordinary skill in the art to employ the nozzle with a jet aircraft, as a well known application of such a nozzle. As for the nozzle being a 3D nozzle, any nozzle can be considered in its broadest sense a 3D nozzle as manufacturing imperfections, tolerances, distortion due to heat, operating conditions, etc cause deviations from an idealized case. As for the temperature being controlled by decreasing the cross sectional area, this is inherently done, as evidenced by Bernoulli's Theorem.

19. Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, 80 are rejected under 35 U.S.C. 103(a) as being unpatentable over McCullough (3,698,642) in view of either Ernst (3,294,323) or the AIAA paper of Miller et al. (AIAA 95-2603) of the IDS, as applied above, and further in view of either Kranz et al. (4,351,479) or Warren (3,204,405). McCullough teaches various aspects of applicant's claimed invention but does not teach the flow is pulsed. Kranz et al. teach a jet engine nozzle 7 having a plurality of injectors (a-f) spaced about the housing, and valve controllers 36 associated with the injectors, the controller directing the injectors to provide an unsteady, i.e. pulsed, fluidic cross flow. The pulsed cross flow is injected to control the effective flow area, throttle and also vector the primary fluidic flow (see especially col. 5, lines 9 and following). The pulsed cross flow partially blocks the opening of the nozzle and can be either symmetric (area control) or asymmetric (thrust vectoring) as desired. Please note that as the effective flow area for the primary fluid flow is controlled, the temperature and pressure of the primary gas is inherently controlled by variation of the primary fluid flow velocity. The pulsed cross flow controller inherently controls the frequency, amplitude and wave form of the pulses. Kranz et al. teach that by employ pulsed flow, more effective deflection of the incoming flow is achieved (col. 1, lines 7 and following). Warren et al teach a thrust vectoring system for a reaction engine where pulsed flow (col. 9, lines 2 and following, especially circa line 63) is injected at the throat (e.g. Fig. 6a, 11, 121) to provide vectoring of the primary fluid. Warren also teach that the pulsed fluid can be fuel. It would have been obvious to one of ordinary skill in the art to employ pulsed flow of the

cross flow injected by McCullough, as taught by either Kranz et al. or Warren et al, to more effective control the cross flow penetration of McCullough, and to enhance the thrust vectoring ability. As for the nozzle being a 3D nozzle, any nozzle can be considered in its broadest sense a 3D nozzle as manufacturing imperfections, tolerances, distortion due to heat, operating conditions, etc cause deviations from an idealized case. As for the temperature being controlled by decreasing the cross sectional area, this is inherently done, as evidenced by Bernoulli's Theorem.

20. Claims 31-33, 35-35, 37, 38, 40-42, 51-54, 56, 57, 59-62, 75-78, 80, are rejected under 35 U.S.C. 103(a) as being unpatentable over the AIAA paper of Miller et al. (AIAA 95-2603) of the IDS in view of McCullough (3,698,642). Miller et al. teach a fixed geometry exhaust nozzle used for gas turbine/turbofan engines (which inherently employ compressors) where the nozzle area is varied by a cross flow injected in the upstream direction (Figs. 2-5) in order to achieve a variable throat area. At the throat, the primary flow reaches the sonic condition. Miller et al show on the cover sheet of the paper that the flows from the primary and secondary injectors can be angled to oppose the flow. Miller et al. do not teach thrust vectoring. However, it is clear that in a fixed nozzle, thrust vectoring capacities are generally required in order to steer the nozzle, especially in a military aircraft. Miller et al further teach very low injection angles are possible (see top left of fig. 9) and hence, as the angles are very low, the angles will also be approximately parallel the vector angle, which would also be low. McCullough teaches a nozzle having a primary flow, a primary injector 16, and a secondary injector

18, and valve controllers 22 to direct a flow to vary the effective throat area of the nozzle and perform thrust vectoring (top of col. 2). McCullough further teaches the use of fuel (col. 2, lines 26-28). Alternately, for the controllers, it is clear that the valves require a controller to actuate them. It would have been obvious to one of ordinary skill in the art to employ a controller in addition to the valves, in order to provide the necessary control over the thrust vectoring and/or throat control. It would have been obvious to one of ordinary skill in the art to both control the throat area and thrust vector the nozzle of Miller et al, as taught by McCullough, in order to add vectoring capabilities to the nozzle of Miller et al. As for the nozzle being a 3D nozzle, any nozzle can be considered in its broadest sense a 3D nozzle as manufacturing imperfections, tolerances, distortion due to heat, operating conditions, etc cause deviations from an idealized case. As for the temperature being controlled by decreasing the cross sectional area, this is inherently done, as evidenced by Bernoulli's Theorem.

21. Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, 80, are rejected under 35 U.S.C. 103(a) as being unpatentable over the AIAA paper of Miller et al. (AIAA 95-2603) of the IDS in view of McCullough (3,698,642), as applied above and further in view of either Kranz et al. (4,351,479) or Warren (3,204,405). Miller et al teach various aspects of applicant's claimed invention but does not teach pulsing the flows nor the flows being fuel. Kranz et al. teach a jet engine nozzle 7 having a plurality of injectors (a-f) spaced about the housing, and valve controllers 36 associated with the injectors, the controller directing the injectors to provide an unsteady, i.e. pulsed, fluidic cross flow.

The pulsed cross flow is injected to control the effective flow area, throttle and also vector the primary fluidic flow (see especially col. 5, lines 9 and following). The pulsed cross flow partially blocks the opening of the nozzle and can be either symmetric (area control) or asymmetric (thrust vectoring) as desired. Please note that as the effective flow area for the primary fluid flow is controlled, the temperature and pressure of the primary gas is inherently controlled by variation of the primary fluid flow velocity. The pulsed cross flow controller inherently controls the frequency, amplitude and wave form of the pulses. Kranz et al. teach that by employ pulsed flow, more effective deflection of the incoming flow is achieved (col. 1, lines 7 and following). Warren et al teach a thrust vectoring system for a reaction engine where pulsed flow (col. 9, lines 2 and following, especially circa line 63) is injected at the throat (e.g. Fig. 6a, 11, 121) to provide vectoring of the primary fluid. Warren also teach that the pulsed fluid can be fuel. It would have been obvious to one of ordinary skill in the art to employ pulsed flow of the cross flow injected by Miller et al, as taught by either Kranz et al. or Warren et al, to more effective control the cross flow penetration, and to enhance the thrust vectoring ability. As for the nozzle being a 3D nozzle, any nozzle can be considered in its broadest sense a 3D nozzle as manufacturing imperfections, tolerances, distortion due to heat, operating conditions, etc cause deviations from an idealized case. As for the temperature being controlled by decreasing the cross sectional area, this is inherently done, as evidenced by Bernoulli's Theorem.

22. Claims 78, 80 are rejected under 35 U.S.C. 103(a) as being unpatentable over **any of the above combinations** as applied above, and further in view of either Terrier (5,665,415) or Justice (6,00,635). The above prior art teach various aspects of applicant's claimed invention but do not specifically teach a 3D fixed nozzle. Terrier teaches (fig. 8) that 3D fixed nozzles, including ultra high aspect ratio biconvex aperture nozzles, are old and well known in the fixed nozzle art. Justice teaches that it is old and well known to employ a 3D fixed nozzle fixed nozzle art with an ultra high aspect ratio trapezoid aperture nozzle 33B (col. 2, circa line 63) is old and well known in the fixed nozzle art.. It would have been obvious to one of ordinary skill in the art employ a 3D nozzle, including either an ultra high aspect ratio biconvex or trapezoid aperture nozzle, as well known types of fixed nozzles utilized in the art.

23. Claim 80 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rich (2,952,123) in view of either Terrier (5,665,415) or Justice (6,00,635). Rich teaches a system for vectoring a primary flow comprising: a nozzle having an inner surface and a throat (Fig. 4), wherein the throat comprises a region within the nozzle of lowest cross section area, the throat being in a path of primary flow of fluid; a plurality of primary injectors 77 arranged along the inner surface of the nozzle, the plurality of primary injectors 77 are individually arranged to oppose the primary flow of fluid (see Fig. 5 and col. 3, lines 25-28 for varying the angle to oppose the flow) in a first intended vectoring plane , and wherein said primary injectors skew an effective throat or sonic plane within said nozzle. Rich does not teach the nozzle is a 3D nozzle but does teach the illustrated

nozzle configuration is nonlimiting (col. 5, lines 48-54). Terrier teach a 3D nozzle (see Fig. 6-9 where the 3D aspect is readily apparent) having primary injectors 24 opposed to the primary flow in the throat. It would have been obvious to one on of ordinary skill in the art to employ a 3D nozzle for the nozzle of Rich as a well known type of nozzle that requires thrust vectoring.

24. Claims 31-33, 35, 37, 38, 40-42, 51-54, 56, 57, 59-61, 75, 77, 78, 80 are rejected under 35 U.S.C. 103(a) as being unpatentable over Terrier (5,664,415) in view of either Rich (2,952,123) or Ernst (3,294,323) and optionally McCullough (3,698,642). Terrier teaches a system for vectoring a primary flow comprising: a 3 D nozzle (see Figs 6-9 where the 3D aspect is readily apparent) having an inner surface and a throat, wherein the throat comprises a region within the 3D nozzle of lowest cross section area, the throat being in a path of primary flow of fluid; a plurality of primary injectors arranged along the inner surface of the 3D nozzle, the plurality of primary injectors 24 are individually arranged to oppose the primary flow of fluid in a first intended vectoring plane, and wherein said primary injectors skew an effective throat or sonic plane within said 3D nozzle. Terrier does not teach additional secondary injectors downstream of the primary injectors to skew the throat or sonic plane. Rich teaches secondary injectors 23 (Fig. 6) downstream of the throat to skew the throat or sonic plane and also teaches the use of fuel. Ernst teaches that it is old and well known in the thrust vectoring art to employ primary and secondary injectors 1, 3 that are either angled perpendicular to the primary flow (Fig. 1) or inclined to oppose the flow (Fig. 3) and shows that the effective vector O

can be increased by using opposed flow (compared Fig. 3 to Fig. 1). McCullough is applied as a teaching reference that teaches that having primary and secondary injectors allows for greater control over the flow to control the effective throat and thrust vectoring and also teaches the use of fuel. It would have been obvious to one of ordinary skill in the art to employ secondary injectors with Terrier to better control the effective throat or sonic plane and thrust vectoring. The use of a controller is taught (col. 6, lines 54+).

25. Claims 31-33, 35-38, 40-42, 51-57, 59-62, 75-78, 80, are rejected under 35 U.S.C. 103(a) as being unpatentable over Terrier (5,664,415) in view of either Rich (2,952,123) or Ernst (3,294,323) and optionally McCullough (3,698,642), as applied above, and further in view of Kranz et al. (4,351,479) or Warren (3,204,405). Kranz et al. teach that by employ pulsed flow, more effective deflection of the incoming flow is achieved (col. 1, lines 7 and following). Warren et al teach a thrust vectoring system for a reaction engine where pulsed flow (col. 9, lines 2 and following, especially circa line 63) is injected at the throat (e.g. Fig. 6a, 11, 121) to provide vectoring of the primary fluid. Warren also teach that the pulsed fluid can be fuel. It would have been obvious to one of ordinary skill in the art to employ pulsed flow of the cross flow injected by McCullough, as taught by either Kranz et al. or Warren et al, to more effective control the cross flow penetration of McCullough, and to enhance the thrust vectoring ability. As for the temperature being controlled by decreasing the cross sectional area, this is inherently done, as evidenced by Bernoulli's Theorem.

Response to Arguments

26. Applicant's arguments filed 2/2/04 regarding the references are not persuasive. Applicant's arguments regarding McCullough are misdirected. Applicant argues the throat of McCullough is concentric and thus not directed to thrust vectoring and cites col. 2, lines 4-8. While it is true that the throat can be concentric (col. 2, lines 4-8), this is for the throat control mode. For thrust vectoring mode the throat is tilted (see col. 2, lines 11-25, which immediately follows applicant's noted citation). Moreover, there is no requirement that the secondary injector of McCullough be located downstream of the throat, rather McCullough teaches that both rows could be upstream or downstream of the throat plane or one of the rows [e.g. the second downstream row] can be located at the throat plane (see col. 1, lines 50-62), hence, there would be no shock waves formed as there is only subsonic flow in this region. Hence, applicant's arguments would only be applicable when there is injection downstream of the fluidic throat. Furthermore, applicant is arguing limitations which are not in all the claims, i.e. "the fluidic injection of the flow into the subsonic portion of the flow field" only applies to some of the claims. There is no such requirement in claims 51 or 80.

27. Applicant's arguments regarding Ernst are not persuasive arguing that Ernst is limited to liquid injection. There is nothing in the broad claims to overcome this limitation as the primary injector is merely required to oppose the primary flow. Again where is this limitation in the independent claims? Applicant further argues the Coanda effect, however, Ernst is cited to show that it is well known to angle the injectors upstream in a cross flow as an alternate arrangement to directly orthogonal to the flow

axis. This is what is fairly taught and Enrst is applied for. Kranz and Warren fairly teach the pulsed flow and it is the combination with e.g. McCullough or Miller that renders the claims unpatentable.

As for the other secondary references, these fairly teach aspects of the claimed invention. However, applicant's arguments are fatally flawed with regard to the rejections applying Miller because applicant never discusses this primary reference. Miller fairly shows the primary and secondary injectors are both upstream of the fluidic throat and thus there is no shock waves formed. Hence, the secondary references fairly teach one of ordinary skill in the art how to modify a throat area control system to also incorporate thrust vectoring by asymmetric injection. Hence, applicant's claims are rendered unpatentable over the combinations and not the secondary references in isolation.

Contact Information

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Ted Kim whose telephone number is 703-308-2631. The Examiner can be reached on regular business hours before 5:00 pm, Monday to Thursday and every other Friday.

The fax numbers for the organization where this application is assigned are 703-872-9306 for Regular faxes and 703-872-9306 for After Final faxes.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Justine Yu, can be reached on 703-308-2675.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist of Technology Center 3700, whose telephone number is 703-308-0861.

General inquiries can also be directed to Technology Center Customer Service Office at 703-306-5648 or the Patents Assistance Center whose telephone number is 800-786-9199. Furthermore, a variety of online resources are available at http://www.uspto.gov/main/patents.htm

Ted Kim
Primary Examiner
March 18, 2004

Ted Kim	Telephone	703-308-2631
Primary Examiner	Fax (Regular)	703-872-9306
March 18, 2004	Fax (After Final)	703-872-9306
Technology Center 3700 Receptionist	Telephone	703-308-0861
Technology Center 3700 Customer Service	Telephone	703-306-5648
Patents Assistance Center	Telephone	800-786-9199